Sediment modeling workshop

Imperial beach, CA. February 25, 2016.

Dr. Thomas Kretzschmar

“Erosion and sedimentation processes in the Tijuana River Watershed” Case study: Los Laureles Canyon

Doctoral Thesis in Environmental Geosciences

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Motivation

How to quantify and model?

In a trans border watershed…

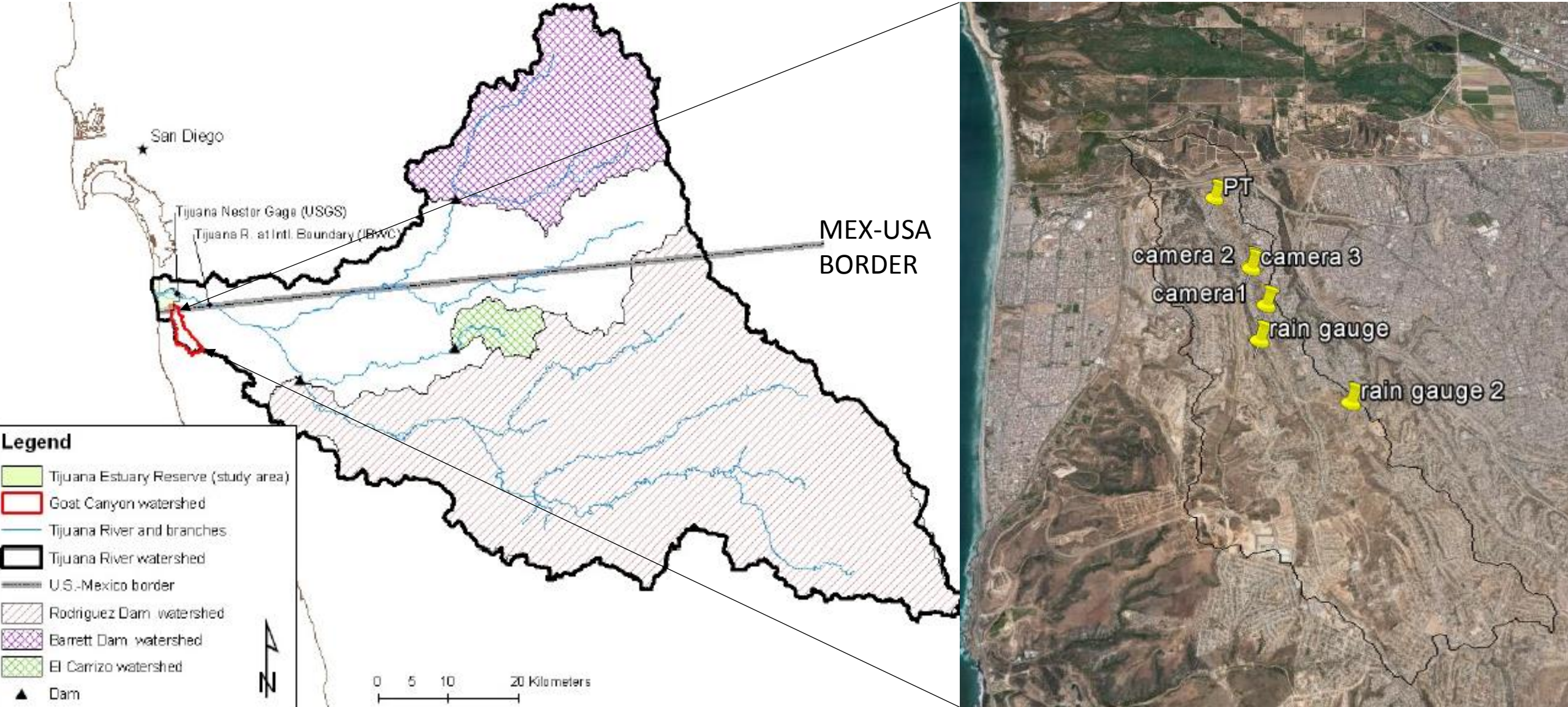
Objectives

1. Assess the contribution of hillslope and gully erosion to total sediment loads under current conditions.

2. Quantify impacts of future land managements/BMP’s on runoff and sediment production.

3. Rapid mapping of ultrafine gully initiation topography using 3D Photo reconstruction.

Tijuana River Watershed



Scientific problem

How urbanization affect runoff and sediment budget?

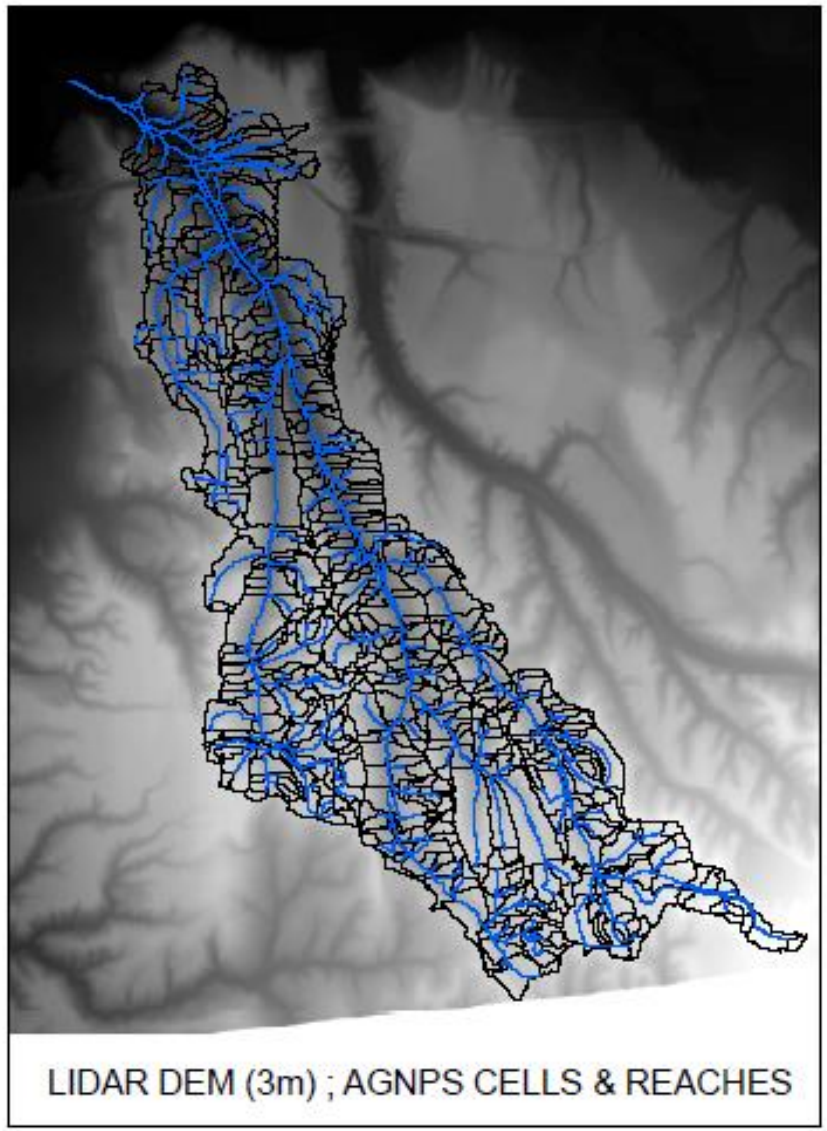
1. Assess the contribution of hillslope and gully erosion to total sediment loads under current conditions.

Method: **AnnAGNPS Model**

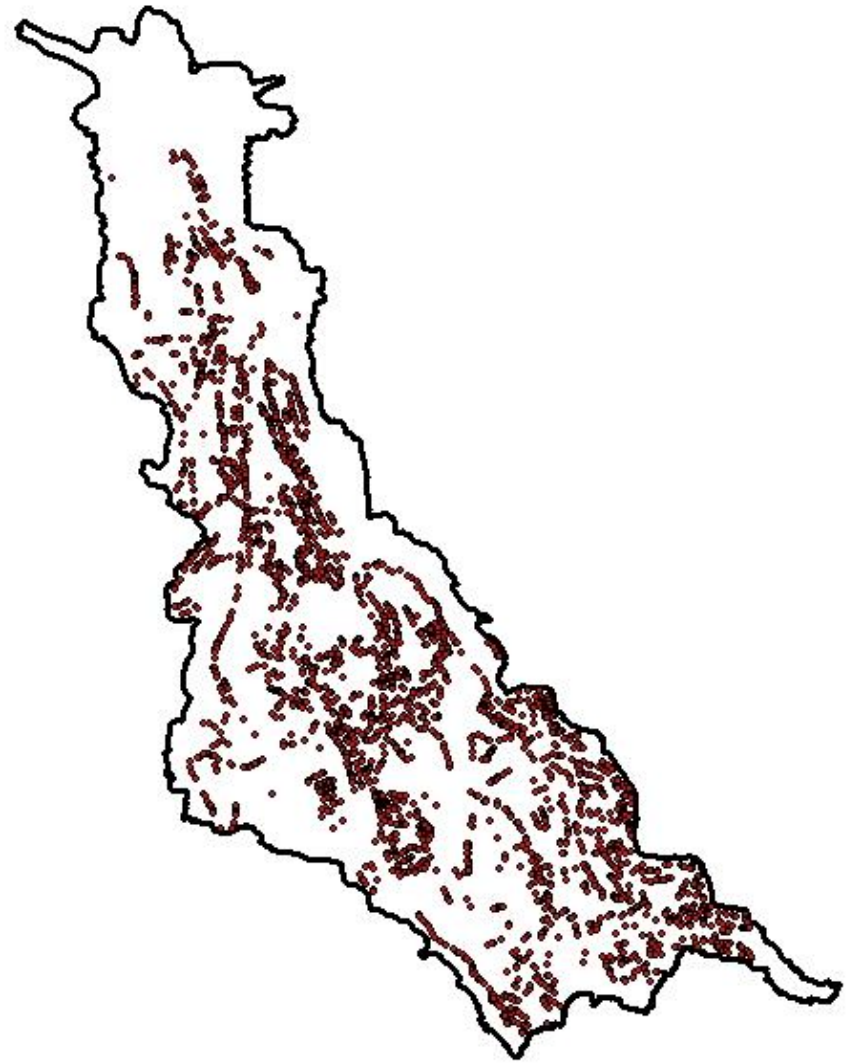
+ Field measurements

Los Laureles Canyon Watershed

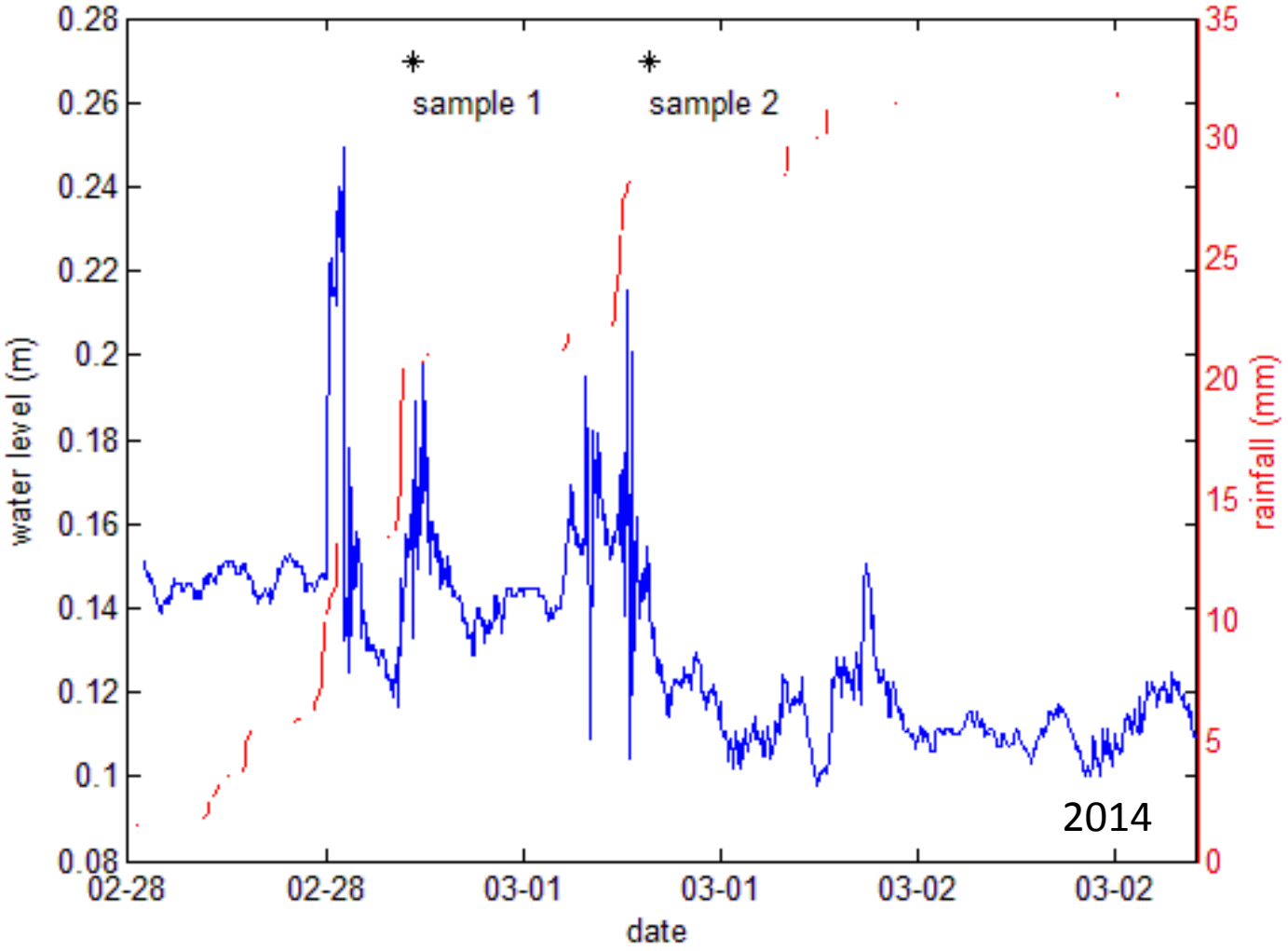
1147Cells; 462 Reaches.



Simulated Gully Locations on Unpaved Roads



Calibration/validation Data



Discharge (cameras)

Suspended sediment samples

- Taken around the PT station:

Sample #	Date	Time	Concentration (g/l)	Discharge (m3/seg)	Sediment Load (kg/s)
1	03-01-2015	7:19am	**15.2**	**6.7**	**101.5**
2	03-01-2015	12:39pm	**19.4**	**3.8**	**74.2**
3	03-01-2015	17:46pm	**13.7**	**3.7**	**51.2**
4	03-02-2015	8:40am	**3.2**	**4.2**	**13.6**

Observed and simulated discharge

Storm event	Rainfall (mm)	Peak (cms) observed	Peak (cms) simulated	Runoff observed (mm)	Runoff simulated (mm)
03-01/03-2014	32.5	0.55	1.22	0.65	2.56
03-01/02-2015	35.5	2.13	3.48	2.1	5.64
05-15-2015	24.4	5.44	1.87	1.7	3.08
09-15/16-2015	30.7	1.62	3.26	2.17	4.87

Validation (Sed traps at the outlet)

Table 2. Observed and modelled annual sediment yield at the outlet of Los Laureles Canyon from AnnAGNPS, under current conditions.

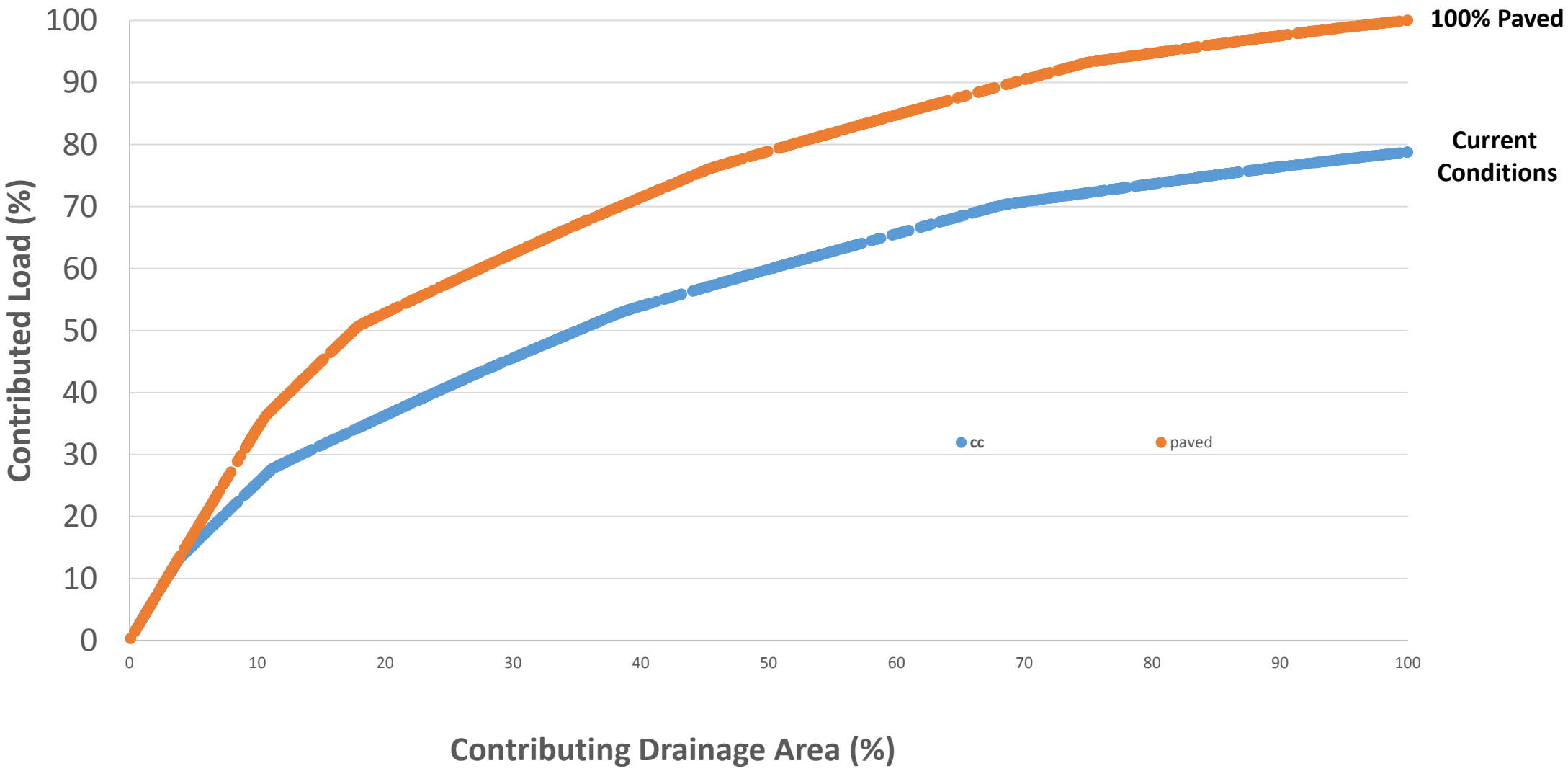
All values in tons per water year (Oct2005-Sept2010)

Water year	AnnAGNPS, sum of input to channels	Observed in trap at outlet (US side)	Relative error (%)
2006	7193	31920	23
2007	37337	31920	116
2008	21313	51072	42
2009	120178	76608	156
2010	57173	70224	82

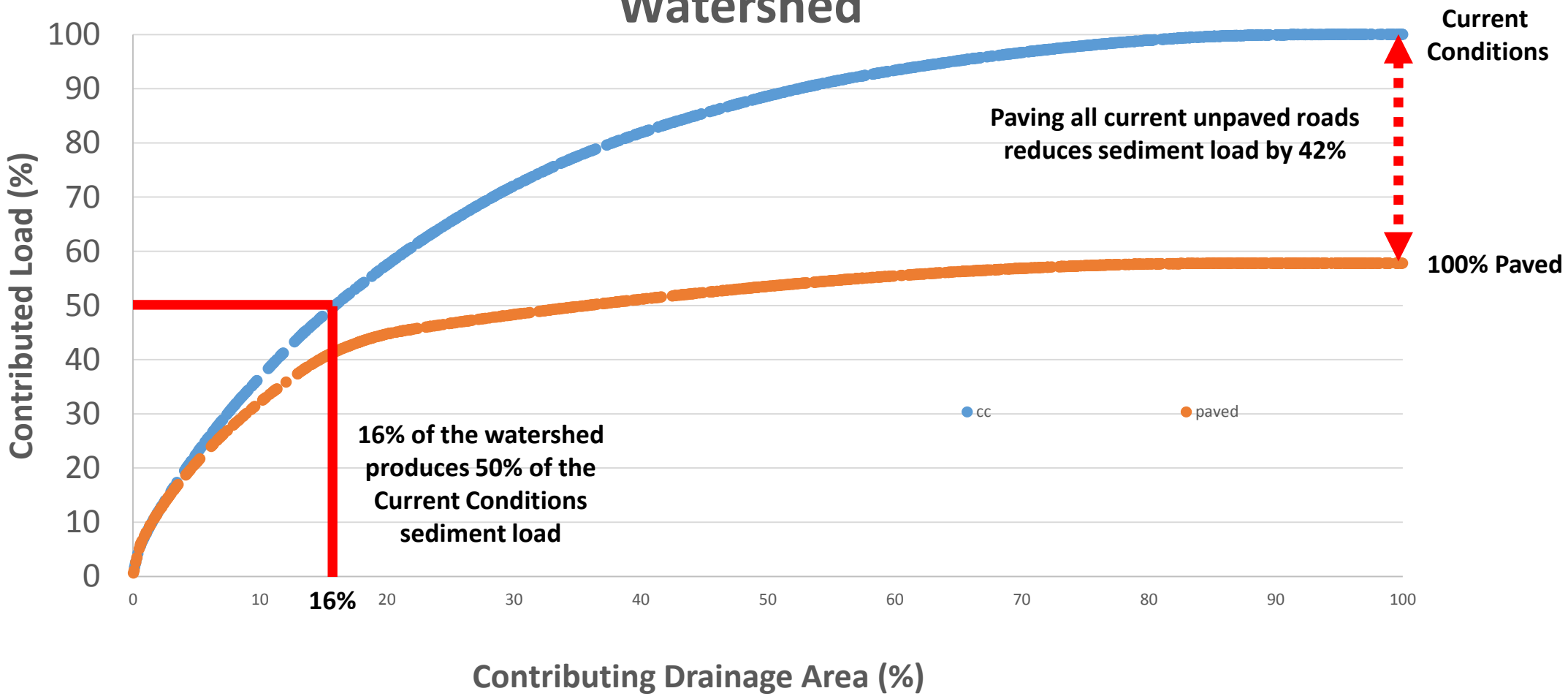
Loads to the Outlet by Source & Scenario

	Runoff (mm)	Peak Discharge (cms)	Total Sediment (t/ha)	Sheet & Rill Sediment (t/ha)	Gully Sediment (t/ha)	Channel erosion (t/ha)
Current Conditions	26.5	2.4	**7.48**	3.90	2.16	1.42
All Paved Roads	31	2.7	**5.84**	4.14	0.0	1.70

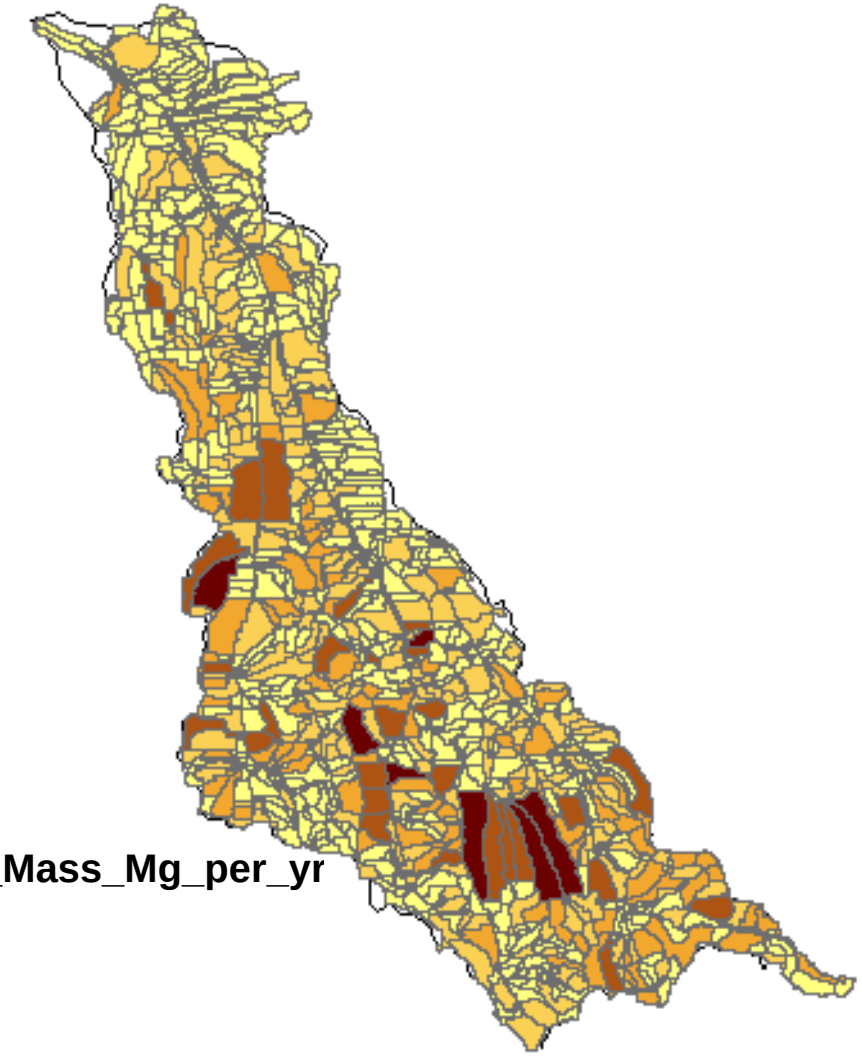
Runoff produced within the Los Laureles Watershed



Total Sediment Production within the Los Laureles Watershed



Total Sediment Load – LL Watershed
Current Conditions

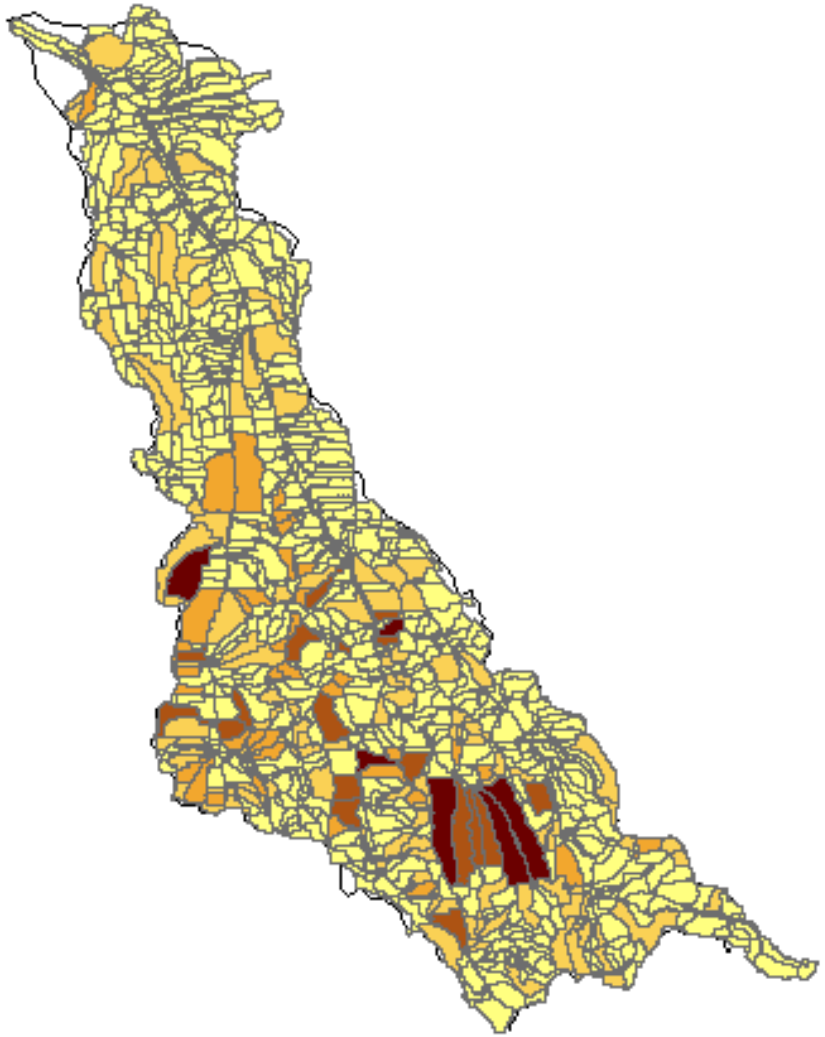


sedcc_spa

Cell_Load_by_Mass_Mg_per_yr

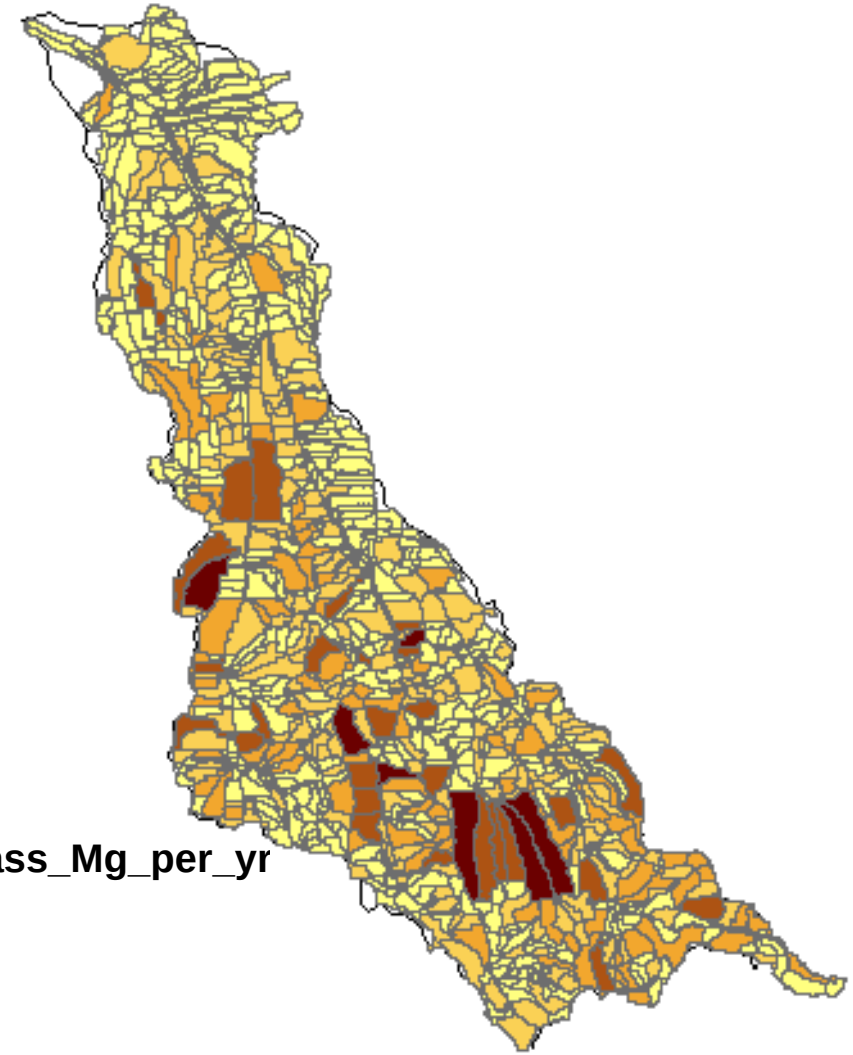
- 0 - 2
- 2 - 6
- 6 - 13
- 13 - 30
- 30 - 60

Total Sediment Load – LL Watershed
All Paved Roads



N

Total Sediment Load – LL Watershed Current Conditions

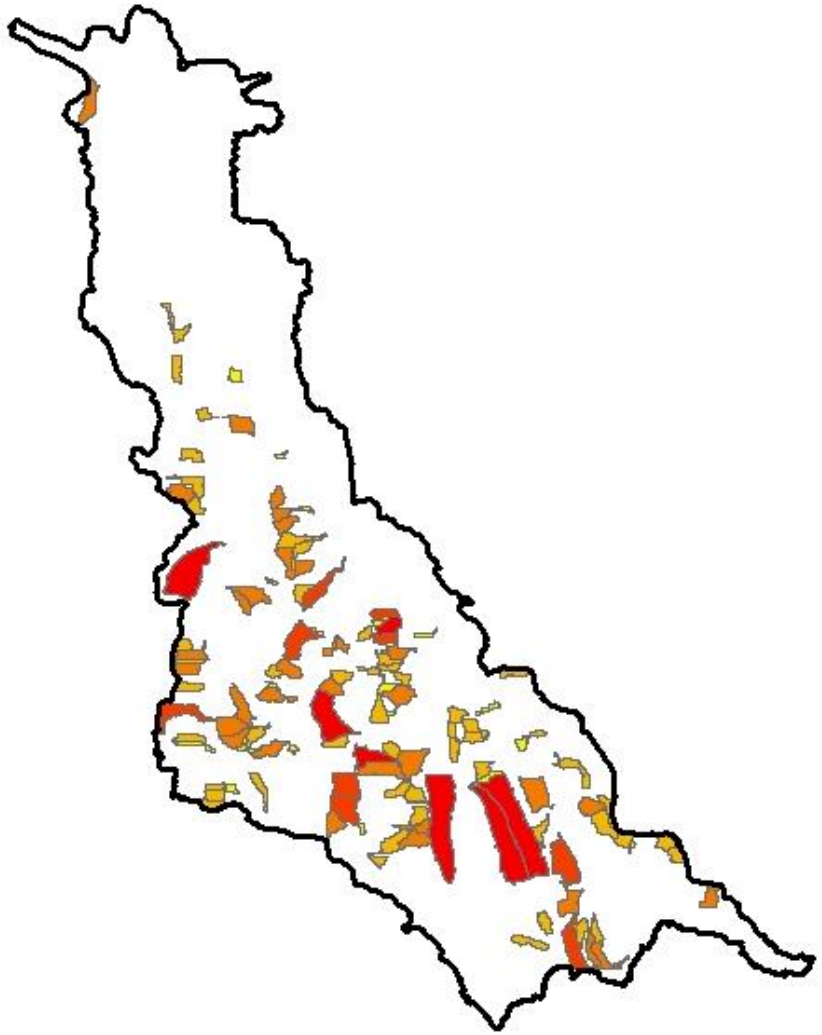


sedcc_spa

Cell_Load_by_Mass_Mg_per_yr

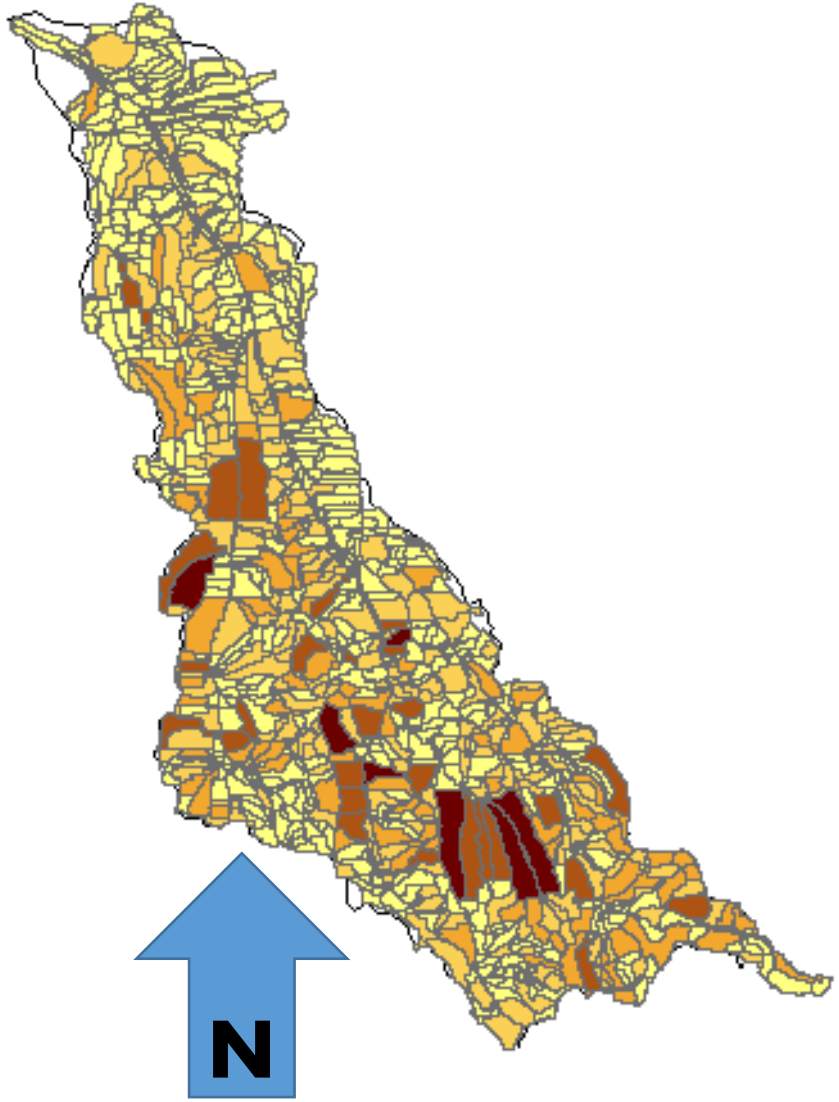
- 0 - 2
- 2 - 6
- 6 - 13
- 13 - 30
- 30 - 60

Areas Simulated Producing 50% of the Total Sediment Load

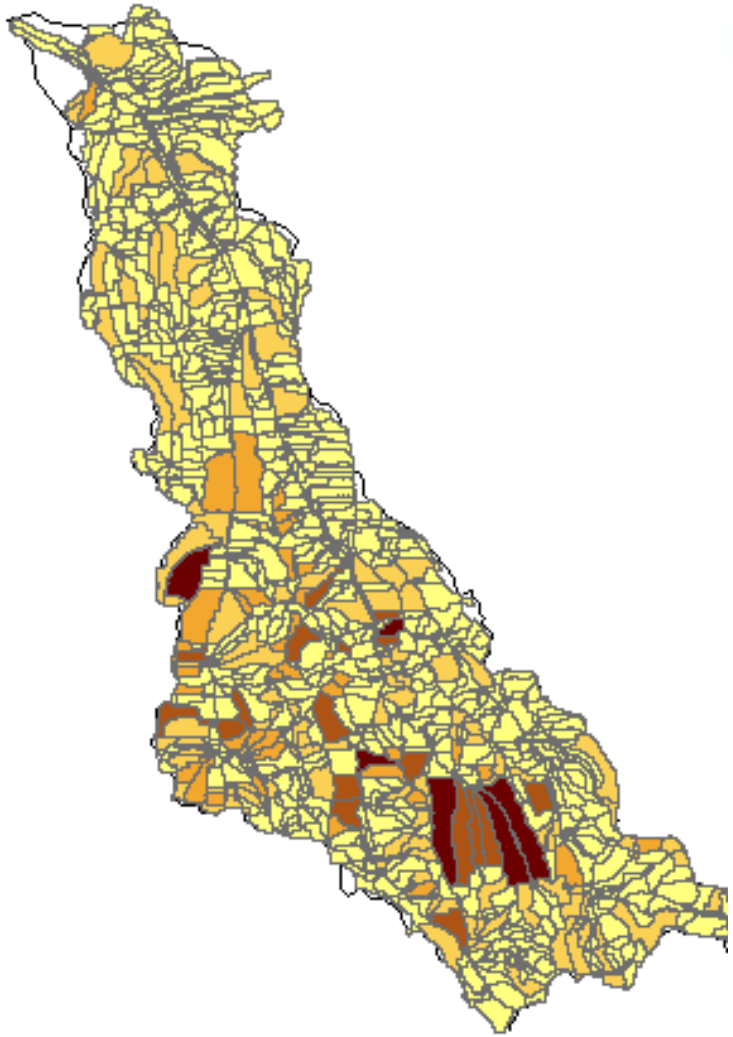


N

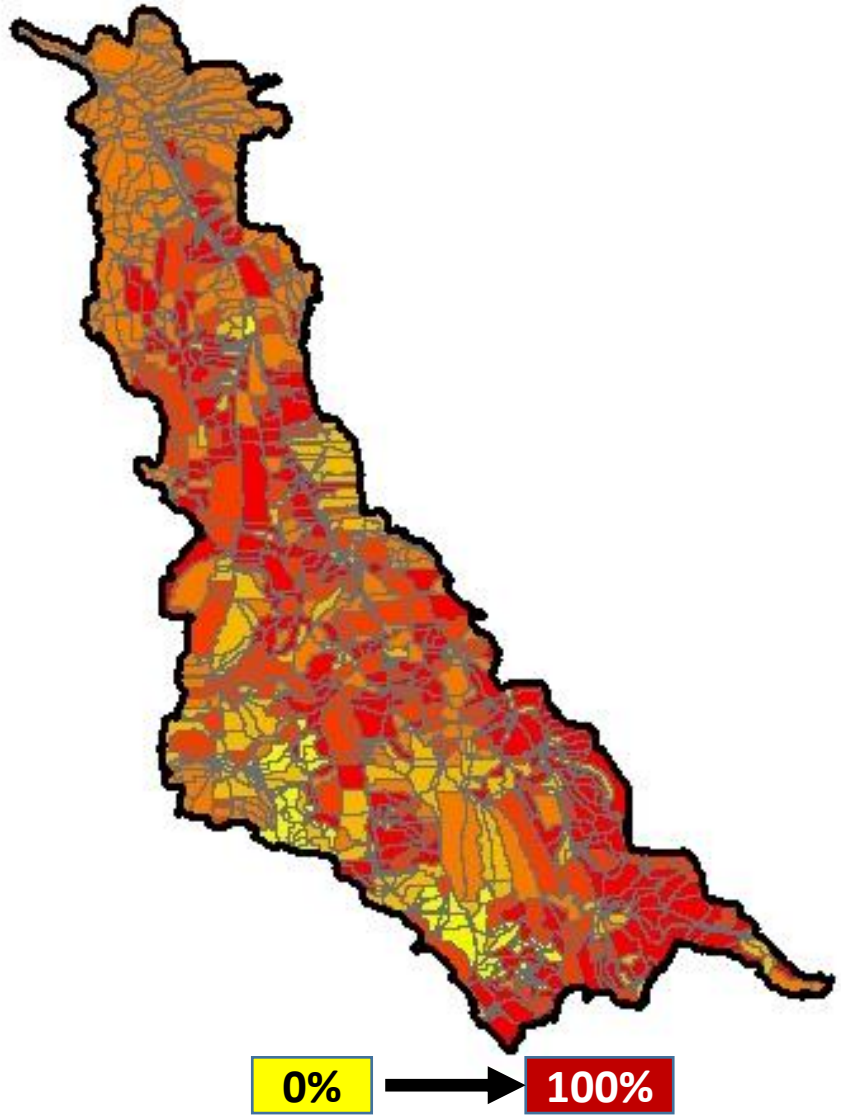
Total Sediment Load
LL Watershed
Current Conditions



Total Sediment Load
LL Watershed
All Paved Roads

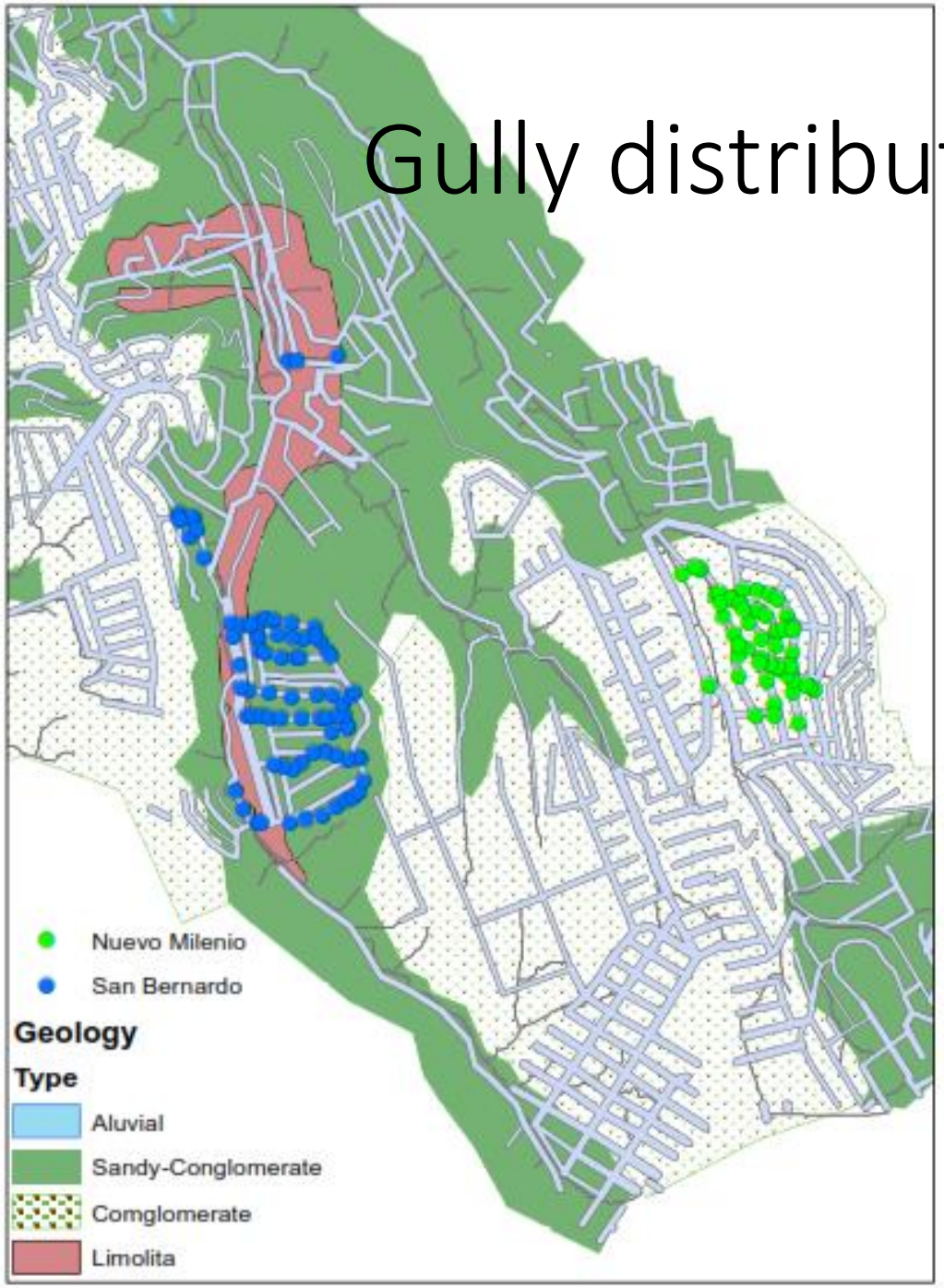


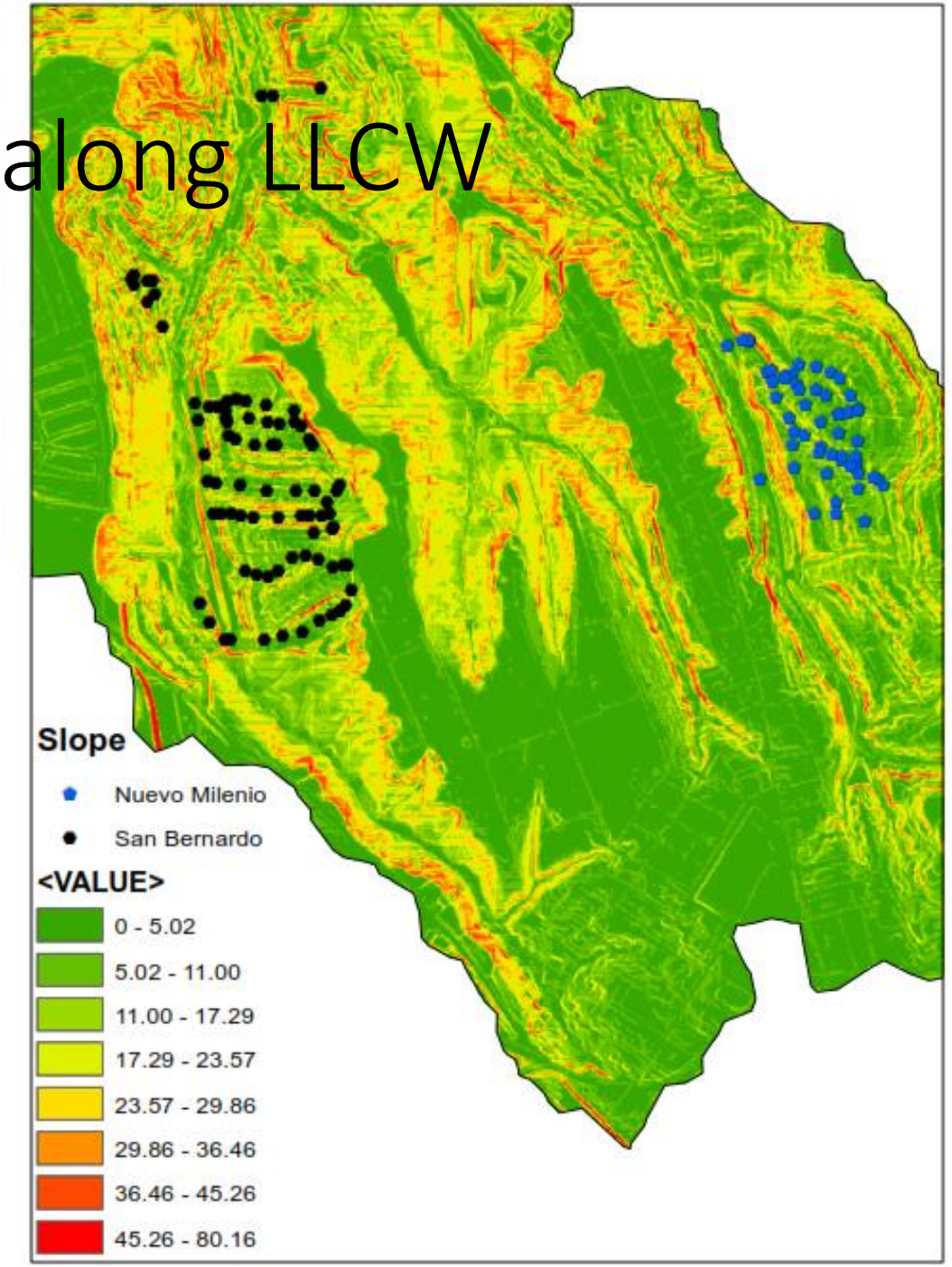
Total Sediment Load Reduction
% Difference Between Current Conditions & All Paved Roads



Gully monitoring

Gully distribution along LLCW





Observed vs Modelled Gullies

Table 3. Observed and modelled sediment yield at each site within Los Laureles Canyon from Gully erosion using the AnnAGNPS model. All values in tons (March 2010).

Location	Observed in the field	Simulated by AnnAGNPS
Nuevo Milenio	209	807
San Bernardo	**1270**	**1509**

Chapter 2:

- Rapid mapping of ultrafine gully initiation topography using 3DPR on a developing watershed in Tijuana Mexico.

Objectives:

3D Photo-reconstruction and quantitative measurement of soil erosion from UAV data during a single storm at LLC Watershed.

Spatial distribution of gully initiation within the LLC Watershed.

3D Photo-reconstruction

(structure from motion)

Drone (DJI phantom2)

Ground Control Points dGPS

Point cloud (AGIsoft)

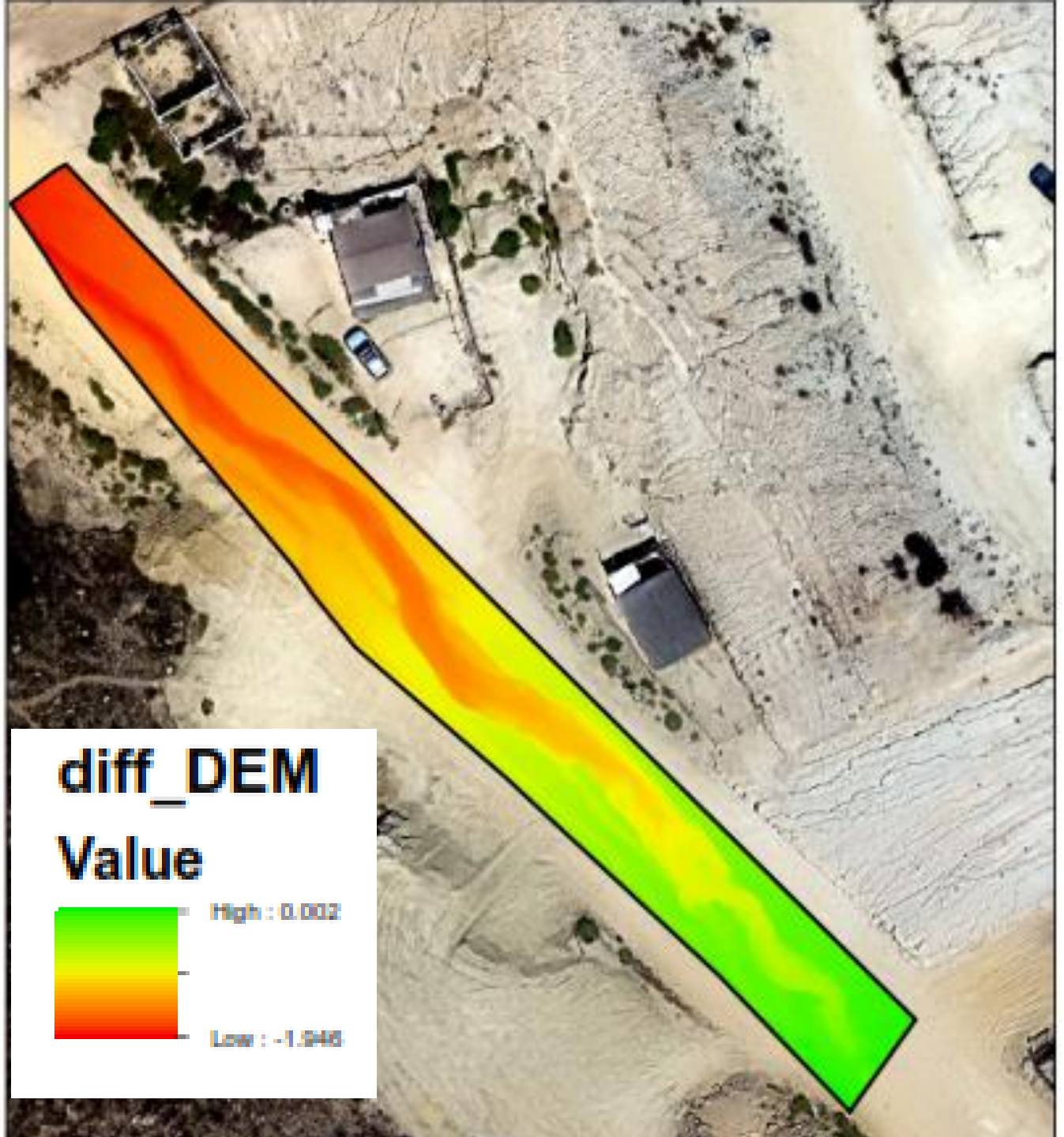
3D Photo-reconstruction

(September 16, 2015)

Before

After

Volume of erosion = ~ **850 m³**
Precipitation = 35mm


diff_DEM
Value
High : 0.002
Low : -1.948

Sub-watershed control

Gully inventory based on drone surveys

San Bernardo

Next steps

- Monitoring more runoff events
- Better calibrate the model
- Additional scenarios for BMP’s evaluations
  - Pervious pavement
  - Revegetation of hillslopes

Muchas gracias